REMARKS

In the Office Action, the Examiner reviewed claims 1-20 of the above-identified US Patent Application, with the result that claims 1-15 were rejected under 35 USC §112, second paragraph, claims 1-6 and 13-18 were rejected under 35 USC §103, and claims 7-12, 19 and 20 were deemed to recite allowable subject matter. In response, Applicants have amended the specification and claims as set forth above. More particularly:

The specification has been amended at paragraphs [0022] and [0026] to address a typographical error regarding the spelling of "René N5."

The specification has been amended at paragraph [0023] to clarify that the scanned images of coatings 1 and 2 are shown in Figures 4 and 3, respectively, consistent with Figures 3 and 4 and paragraph [0025].

Independent claims 1 and 16 have been amended to cancel the limitations regarding the relative thicknesses of the interior region (32) and the outer surface region (34), and claim 16 has also been amended to cancel the limitations regarding the hardness of the outer surface region (34).

Independent claims 1 and 16 have been further amended to use the term "grains" instead of "columns" for consistency with the specification (e.g., at paragraph [0019] - "columnar grains 30").

Independent claims 1 and 16 have also been amended to specify that at least a

portion of the columnar microstructure of the TBC (26) has feathery grains (30). Support for this amendment can be found in Applicants' specification at paragraph [0019] and Figures 2 through 10.[1]

Independent claims 1 and 16 have also been amended to specify that the grains (30) of the outer surface region (34) are denser and more columnar than the grains (30) of the interior region (32). Support for this amendment can be found in Applicants' specification at paragraph [0026] ("the coating . . . (Figures 7 and 8) resulted in a more columnar and denser grain structure, while the coating . . . (Figures 5 and 6) was not as columnar and had more widely-spaced feathery grains (30) resulting in a more porous microstructure.") and Figures 2 and 6 through 8.

Independent claim 1 has also been amended to specify that the grains (30) of the interior region (32) and outer surface region (34) are oriented substantially normal to the surface (22) of the component (10). Support for this amendment can be found in Applicants' Figures 2 through 10.

---

[1] According to MPEP §2163 II.A.3(a), "drawings alone may provide a 'written description' of an invention as required by [35 USC §112, first paragraph]," and "[i]n those instances where a visual representation can flesh out words, drawings may be used in the same manner and with the same limitations as the specification." (Citations omitted).

New dependent claims 21 and 24 (which depend from claims 1 and 16, respectively), recites that both the interior region (32) and the outer surface region (34) comprise feathery grains (30), the grains (30) of the interior region (32) are more feathery than the grains (30) of the outer surface region (34), and the feathery grains (30) of the outer surface region (34) are denser and less porous than the feathery grains (30) of the interior region (32). Support for this amendment can be found in Applicants' specification at paragraph [0025] ("coatings identified as having "dense feathers" (coatings 3, 8, and 9) also performed very well"), paragraph [0026] ("the coating deposited with higher electron beam energy (Figures 7 and 8) resulted in a more columnar and denser grain structure, while the coating deposited with lower electron beam energy (Figures 5 and 6) was not as columnar and had more widely-spaced feathery grains (30) resulting in a more porous microstructure"), and Figures 2 through 8.

New dependent claims 22 and 25 (which depend from claims 1 and 16, respectively) recite that the outer surface region (34) does not contain feathery grains (30). Support for this amendment can be found in Applicants' specification at paragraph [0026] ("the outer surface region . . . of this coating specimen was fully densified") and Figures 9 and 10.

New dependent claim 23, which depends from claim 16, recites the limitation now included in claim 1 that requires the grains (30) of the interior region (32)

and the outer surface region (34) to be oriented substantially normal to the surface (22) of the component (10).

New independent claim 26 has been presented that is identical to claim 1 as filed except for incorporating the limitations of its dependent claim 7, pursuant to the Examiner's conclusion that claim 7 recited allowable subject matter. As such, new independent claim 21 is believed to be allowable over the prior art of record.

Applicants believe that the above amendments do not present new matter. Favorable reconsideration and allowance of claims 1-26 are respectfully requested in view of the above amendments and the following remarks.

Rejection under 35 USC §112, Second Paragraph

Claims 1-15 were rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter that Applicants regard as their invention. Applicants respectfully request favorable reconsideration in view of the following comments.

Regarding claim 1, the Examiner's concern was:

> Claim 1 states that the interior region is formed of a ceramic material so as to have a lower thermal conductivity than zirconia stabilized by about 7 wt% yttria. The claims also make zirconia stabilized with yttria a possible ceramic composition for the coating. It is not clear how the ceramic material has a lower thermal conductivity. Is there a different amount of yttria added?

In response, Applicants direct the Examiner's attention to paragraphs [0007] and [0020] of their specification, where Applicants disclose

> Both regions are formed of a ceramic material, with the ceramic material of at least the interior region having a lower thermal conductivity than zirconia partially stabilized by about seven weight percent yttria, e.g., zirconia (ZrO_2) containing . . . yttria (Y_2O_3; e.g., more than 7 weight percent yttria if yttria is the only additive oxide).
>
> Paragraph [0007].

> Yttria can also be used as an additive oxide to zirconia for purposes of this invention, though preferably in amounts greater than 7 weight percent (for example, 20 weight percent) if it is the only additive oxide since the thermal conductivity of YSZ decreases with increasing yttria content.
>
> Paragraph [0020].

Therefore zirconia stabilized with yttria is a possible ceramic composition for the coating, since zirconia stabilized by more than 7 wt% yttria has a lower thermal conductivity than zirconia stabilized by 7 wt% yttria.

Regarding claim 3, the Examiner's concern was:

> Claim 3 states that the thermal barrier coating consists essentially of zirconia and a stabilizer. The thermal barrier coating comprises both the outer and inner regions. It is not clear how they could not have the same composition if the entire thermal barrier coating is said to consist essentially of a certain material. How is claim 4 further limiting? The same analysis applies to claim 6.

First, Applicants wish to clarify that claim 3 recites "the thermal barrier coating consists essentially of zirconia and *at least one of* ytterbia, yttria, neodymia, lanthana, hafnia, tantala, gadolinia, erbia, and dysprosia." (Emphasis added.) This recitation allows the interior region 32 to contain, for example, only zirconia and ytterbia, while the outer surface region 34 contains, for example, only zirconia and yttria. The resulting TBC 26, as a whole, would only contain (consist of) zirconia, ytterbia, and yttria.

Next, Applicants note that the interior region 32 and the outer surface region 34 can consist essentially of zirconia and the same stabilizer, yet also have different compositions because they contain different amounts of the stabilizer. For example, note the following statement in paragraph [0022]:

> The compositions of the TBC's were varied by small variations in the yttria content (about 4 to about 7 weight percent) . . ..

In view of the above, the further limitation in claims 4 and 6 that "the ceramic materials of the interior region and the outer surface region have the same composition" stipulates that not only do the interior region and the outer surface region contain the same base composition (e.g., zirconia) and stabilizer(s), but also the same relative amounts of the base composition and stabilizer(s).

The Examiner's concern for claim 9 is related to her concern for claim 3.

Specifically:

> Claim 9 states that the inner and outer regions are composed of different materials. However, the first region may be zirconia and an additional ceramic selected from a group that includes yttria, and the second region is zirconia stabilized by yttria. Should yttria not be a choice for a stabilizer in the first region?

Applicants wish to clarify that claim 9 recites "the ceramic materials of the interior region and the outer surface region do not have the same *composition*." (Emphasis added.)

Applicants note that the interior region 32 and the outer surface region 34 can consist essentially of zirconia and yttria, yet have different compositions because they contain different amounts of yttria. Again, this distinction is evident from paragraph [0022]:

> The compositions of the TBC's were varied by small variations in the yttria content (about 4 to about 7 weight percent) . . ..

In view of the above, Applicants believe that claims 1-15 are not indefinite when Applicants' specification is used to analyze the definiteness of the claim language (MPEP §2173.02). Therefore, Applicants respectfully request withdrawal of the rejection under 35 USC §112, second paragraph.

Rejections under 35 USC §103

Independent claims 1 and 16 and their dependent claims 2-4, 13, 14, 17, and 18 were rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 6,183,884 to Rickerby, and independent claim 1 and its dependent claims 2-6, 13, and 15 were rejected under 35 USC §103(a) as being unpatentable over U.S. Patent No. 6,689,487 to Murphy. Applicants respectfully request reconsideration of these rejections in view of the following comments.

As recited in independent claims 1 and 16, Applicants' invention is a thermal barrier coating (TBC 26) having an interior region (32), an outer surface region (34) on the interior region (32), and a columnar microstructure whereby the interior region (32) and the outer surface region (34) comprise columnar grains (30). At least some of the grains (30) within the columnar microstructure are feathery, and the grains (30) of the outer surface region (34) are denser and more columnar than the grains (30) of the interior region (32). Claim 1 further requires that the columnar grains (30) are oriented substantially normal to the surface (22) on which the TBC (26) is deposited.

Under the first §103 rejection (rejecting claims 1-4, 13, 14, and 16-18), the Examiner's position was generally that Rickerby's TBC (38 in Figures 2 and 2A; 68 in

Figure 3; 98 in Figure 4; 126 in Figure 5; 148 in Figure 6) has first (e.g., interior) and second (e.g., exterior) regions, and that the columns (e.g., grains 40 in Figure 2) widen toward the outer surface of the TBC, such that the columns are more closely spaced in the exterior region of the TBC than in the interior region. The Examiner further stated "Rickerby teaches that the coating has a lower thermal conductivity than a typical YSZ layer."

However, Applicants independent claims 1 and 16 require that grains (30) in the outer surface region (34) are denser and more columnar than the grains (30) in the interior region (32), and at least some of the grains (30) within the columnar microstructure are feathery. In contrast, Rickerby teaches nothing regarding the columnarity of the individual grains 40, and nothing regarding the grains 40 having a feather microstructure.

In view of the above, to meet the structural requirements of Applicants' independent claims 1 and 16, Rickerby's TBC's would have to be modified in a manner not taught or suggested by Rickerby. Therefore, Applicants respectfully request withdrawal of the first rejection of the claims under 35 USC §103.

Under the second §103 rejection (rejecting claims 1-6, 13, and 15), the Examiner's position was generally that Murphy's TBC 30 has a first (interior) region 30a having primary columnar grains "C" and a second (outer) region 30b that has

primary columnar grains "C" and additionally secondary columnar grains "SC" (Figure 2B). The Examiner further stated "These secondary grains are considered to be more closely spaced than the columns of the first region."

Murphy's "primary columnar grains" C appear to be similar to the columnar grains 30 of Applicants' TBC 26, and Murphy's "secondary grains" SC appear to cause the primary columnar grains C to have a similar microstructure to the "feathery" grain structure within Applicants' interior region 32. The inherent spaces between individual secondary grains SC within Murphy's outer region 30b result in the outer region 30b being less columnar and less dense. Murphy's teachings are limited to the secondary grains SC being present in at least the outer region 30b (Figures 2A and 2B - optionally also in the interior region 30a as shown in Figure 2A), and therefore are the very opposite of what is recited in Applicants' independent claim 1 (the grains 30 in the outer surface region 34 are denser and more columnar than grains 30 of the interior region 32). While the Examiner pointed out that Murphy's "secondary grains are considered to be more closely spaced than the columns of the first region," Applicants' claim 1 specifies that the "grains" recited as being "more closely spaced" are oriented normal to the surface (22) on which the TBC (26) is deposited, whereas Murphy's secondary grains SC, though arguably being more closely spaced than the primary grains C, are oriented at an acute angle to the surface 12 on which Murphy's TBC 30 is deposited.

In view of the above, to meet the structural requirements of Applicants'

independent claim 1, Murphy's TBC would have to be modified in a manner not taught or suggested by Murphy. Therefore, Applicants also respectfully request withdrawal of the second rejection of the claims under 35 USC §103.

Closing

In view of the above, Applicants believe that the rejections to their claims have been overcome, and that the claims define patentable novelty over all the references, alone or in combination, of record. It is therefore respectfully requested that this patent application be given favorable reconsideration.

Should the Examiner have any questions with respect to any matter now of record, Applicants' representative may be reached at (219) 462-4999.

Respectfully submitted,

By Domenica N S Hartman
Domenica N.S. Hartman
Reg. No. 32,701

January 21, 2005
Hartman & Hartman, P.C.
Valparaiso, Indiana 46383
TEL.: (219) 462-4999
FAX: (219) 464-1166

Attachment: Fee Transmittal form